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The fossil remains of the deer, at first supposed to belong to an extinct species, for which the name of *Cervus muscatinensis* was suggested, were discovered in grading a street in the city of Muscatine. From the Loess of the same locality Prof. Witter has collected the following fossil shells: *Helix striatella*, *H. fulva*, *H. pulchella*, *H. lineata*, *Pupa muscorum*, *P. blandi*, *P. simplex*, *Succinea obliqua*, *S. avara*, *Limnea humilis*? and *Helicina occulta*.

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FEBRUARY 11.

The President, Dr. RUSCHENBERGER, in the chair.

Thirty-one persons present.

*Natives of Botel Tobago.*—The President read the following extract from a letter by Dr. CHARLES A. SIEGFRIED, U. S. N., dated December 20, 1878: "We visited an island called Botel Tobago, while surveying a rock, 80 miles east of South Cape of Formosa. We found a race of aborigines, probably from Malay stock. They knew nothing of money, rum, or tobacco. They gave us goats and pigs for tin pots and brass buttons, and would hang around us all day in their canoes, waiting for a chance to dive for something thrown overboard. They wore clouts only; ate taro and yams mainly, though they have pigs, goats, chickens, and fish, and cocoanuts also. Snakes abound, of the boa variety I judge. Their thatch houses are low, with much overhang of the roof, surrounded by stone walls, strongly made of laid stone to protect them from monsoons. Their paddy fields contain immense quantities of taro, *Colocasia aroidea* my botany says. They are peaceful and timid, do not mark the body or deform the face or teeth, and seem happy enough in their condition. I found them fairly healthy. They had axes, spears, and knives, but all of common iron, the axe being made by imbedding the handle instead of the handle piercing the iron, as with us. Their canoes are beautiful, made without nails, and are ornamented usually with geometrical lines. The hair is worn naturally, the men partly clipping theirs. I saw no valuable metal. They wore the beards of goats, with small shells, as neck ornaments."

*Cutting or Parasol Ant, Atta fervens*, Say.—The Rev. H. C. McCook stated that he had in course of preparation a detailed account of the architecture and habits of the Cutting Ant of Texas. The observations, of which he proceeded to give an abstract, were made during an encampment for purposes of study, south of Austin, Texas.

1. *Exterior Architecture.*—Two forms were noted. The first, seen at a point distinguished as Camp Wright, was that of a

mound, 21 feet long, and about 4 feet high, which had been accumulated around the trunk of a double live-oak tree, *Quercus virens*, which stood on the side of a road. The second form was located at a point distinguished as Camp Jeanes. It was on a high, flat, upland prairie, and was a bed of denuded earth, in the midst of the grassy open, 8 feet 9 inches long, and 7 feet, more or less, across. Over this denuded surface were scattered between twenty and thirty circular, semicircular, and S-shaped elevations of fresh earth-pellets. The circular moundlets had the appearance of an American spittoon, the resemblance being stronger by reason of a round open entrance or gallery door in the centre. All had apparently been naturally formed by the gradual accumulation of the pellets of sandy soil, as they were brought out, and dumped upon the circumference of the heap. The moundlets were massed at the base, and gradually sloped off towards the top. They were from 3 to 4 inches high. This "bed" (as the natives call it) was quite free from grass, as was also the mound at Camp Wright. Another nest of the same character was found at Camp Jeanes; this was situated in a grove, but was fully exposed to the sun. A fourth nest was found about a mile distant from this spot, of the same character. This is, therefore, probably the normal form of the external architecture of the formicary, the mound at Camp Wright being probably formed by accumulations around the tree, caused by the bordering road, which restricted the limits of the gates, and so threw the separate moundlets back upon each other.

2. *Gates or Doors*.—His first view of the mound at Camp Wright led him to fear that he had made a mistake, and pitched his camp near an abandoned nest. There was not a sign of life. The mound was covered over with earthen knobs or warts of various sizes, but the action of a recent shower upon the black soil gave the hill the appearance of an old one. Here and there were scattered over the surface small irregular heaps of dry leaves, bits of leaves, and twigs. Otherwise, the mound seemed lifeless, deserted. As the evening began to fall the scene was wholly changed. Hosts of ants, of various sizes, and in countless numbers, were hurrying out of open gates into the neighboring jungle, and two long double columns were stretched from the bottom to the top of the large overhanging live oak. The ants in the descending columns all carried above their heads portions of green leaves, which waved to and fro and glanced in the lantern light, giving to the moving column a weird look, as it moved along. It seemed like a procession of Lilliputian Sabbath-school children bearing aloft their banners. It is this habit which has given this insect in some quarters the popular name of the "Parasol Ant." It is also called in Texas the "Brazilian Ant," but is quite universally known as the "Cutting Ant," certainly a most appropriate name.

The opening and closing of the gates occurs before and after

every exit from the nest. The process is a long, careful, and complicated one, and was studied fully. Towards evening the gates are gradually thrown open, and so remain until morning, when they are gradually closed, the process continuing in some cases until  $10\frac{1}{2}$  A. M. The closing is done by carrying into the gallery bits of dry twigs of various lengths, some as long as  $1\frac{1}{2}$  inch, dry leaves, and other refuse. A number of closed gates were opened to note the depth to which this refuse was placed. It varied from one-half inch to an inch and a half from the surface. In some cases the gallery had been sealed up with sand pellets *below* the refuse. The galleries quite often slant inward from the gate, and at as great an angle as  $45^\circ$ . They also sometimes divide a short distance from the surface. These conformations allow more readily the process of closing. In carrying in the refuse the larger forms of the ant are engaged; as the hole gradually closes, only the very smallest appear. The last touches are carefully and delicately made by the minims, who, in small squads, fill in the remaining interstices with minute grains of sand, and finally, the last laborer steals in behind some bit of leaf, and the gate is closed. It then presents to the casual observer the appearance above described of a little heap of dry chips accidentally accumulated upon the mound. The galleries at Camp Jeanes were closed in the same manner.

When the gates are opened at dusk, this process is reversed. The minims first appear, deporting from the heap particles of sand. Larger forms follow, carrying away bits of refuse, which they drop a couple of inches more or less from the gate. This is a slow process, and apparently little is accomplished for a long time. But evidently the whole mass of refuse is thus loosened. Then comes the final burst, with soldiers, majors, and minors in the lead, who rush out bearing up before them the rubbish, which flies here and there, and in a few moments is cleared away from the gallery, and spread around the margin of the gate. These chips are evidently gathered together for this purpose, and are among the "treasures" of the ants, being kept near by for this use. The pieces were easily identified as being thus used several days in succession.

The above observation points out at least the use found for the extremely small forms peculiar to this species. At least ten distinct castes (forms or sizes) were exhibited to the Academy. They vary as follows, the measurements being in sixteenths of an inch, viz., ♀, 14; ♂, 11; soldier 7; worker major 6; minor 5; and the remaining castes in the proportion,  $3\frac{1}{2}$ , 3,  $2\frac{1}{2}$ , 2,  $1\frac{1}{2}$ , 1. A more careful comparison may possibly reduce this series one or two. But the result, as above, will probably stand.

The gates first opened are the first closed, and those last opened are the last closed.

3. *Leaf-cutting Habit.*—The whole process of cutting and car-

rying leaves from trees and shrubs was observed at Camp Wright, and at a vegetable garden near Austin. In order better to see the mode of cutting, small tender branches of live-oak were thrust into the mound near the gates. These were soon covered with ants, and as the lantern could thus be used conveniently, the operations of the cutters were completely in view. The cutter grasps the leaf with outspread feet, and makes an incision at the edge by a scissors-like motion of her sickle-shaped toothed mandibles. She gradually revolves, steadily cutting as she does so, her mandibles thus describing a circle, or the greater portion thereof. The feet turn with the head. The cut is a clean one, quite through the leaf. The cutter will sometimes drop with the excision to the ground, sometimes retire when the section has dropped, sometimes (it is inferred) seize the section and carry it down the tree. A division of labor was apparent. At the foot of one tree was a pile of cut leaves, to which clippings were continually being added by droppings from above. Carriers on the ground took these up, and bore them to the nest. The loading of the cuttings is thus: the piece is seized by the curved mandibles, the head is elevated, the piece is thrown back by a quick motion, seeming to be lodged on its edge within the deep furrow that runs along the entire medial line of the head (except the clypeus), and supported between prominent spines on the edge of this furrow and on the prothorax. The furrow and spines thus appear to serve a very useful end. The cutting and carrying were not done (so far as noted) by the smaller castes. The soldiers rarely engaged in this work, but were seen to precede the excursion columns as they moved out and up the tree, and afterward to return, as though engaged as scouts or pioneers.

The principal leaves gathered at Camp Wright were those of the live-oak. The young saplings in the neighborhood of the mound were in great part or entirely defoliated. The great tree above was in parts stripped to the very top. So also was some wild vine unknown to him. In beginning work the cutters seem to aim first at the topmost leaves. A nest on the grounds of an intelligent nurseryman and gardener near Austin was visited, and from the proprietor many facts were learned. Ants were here seen at work late in the afternoon. They had come up through the garden from the formicary, three hundred feet distant. They prefer trees with a smooth leaf; are severe upon grapes, peaches, the China tree, radishes; take celery, beets, young corn and wheat, plum, pomegranate, honeysuckle, cape jessamine, crape myrtle, althea. They do not like lettuce, won't take the paper mulberry, nor figs and cedar, except the bud ends in the scant days of winter. They love sugar, grain, and tobacco! This proprietor assured Mr. McCook that the ants made foraging excursions into his house, entered his desk-drawers, and carried away a portion of his chewing tobacco before he discovered the rob-

bery. He had to be very careful thereafter where he deposited the delectable weed. Mr. McCook saw at another plantation an immense column engaged in plundering a granary of wheat, which was being carried away to the nest.

4. *Interior Architecture.*—The use of this leaf material, in part at least, was unfolded when the work of excavation began. Two trenches were made, one ten feet long, five feet deep, and a second at right angles to it, and wide enough to allow free entrance and study. The number of insects that swarmed to the defence of their home is simply amazing. They were, however, not so difficult to manage as sometimes when disturbed at their night work, as the swift use of the spade by the assistants and the general convulsion of their emmet world quite dazed most of them. However, when the speaker himself entered the trench to work with trowel, knife, rule, etc., the ants rallied, and attacked so fiercely that the men were compelled to brush them off. The wound inflicted by them was sharp, but nothing to compare with the severe sting of the agricultural ant. The interior of the formicary may be briefly described as an irregular arrangement of caverns communicating with the surface and with each other by tubular galleries. These caverns or pockets were of various sizes, 2 feet 10 inches long and less, and 12 inches deep and 8 inches high and less. Within these chambers were masses of a very light, delicate leaf-paper wrought into what may properly be called "combs." Some of the masses were in a single hemisphere, filling the central part of the cave, others were arranged in columnar masses  $2\frac{1}{2}$  inches high, in contact along the floor. Some of these columns hung, like a rude honey-comb or wasp-nest, from roots which interlaced the chamber. The material was in some cases of a gray tint, in others of a leaf-brown. It was all evidently composed of the fibre of leaves which had been reduced to this form within the nest, probably by the joint action of the mandibles and salivary glands. On examination they proved to be composed of cells of various sizes, irregular in shape, but maintaining pretty constantly the hexagon. Some of the cells were one-half inch in diameter, many one-fourth inch, most of them one-eighth inch, and quite minute. Large circular openings ran into the heart of the mass. Some of the cells were one inch deep; they usually narrowed into a funnel-like cylinder. Ants in great number, chiefly of the small castes, were found within these cells. In the first large cave opened were also great numbers of larvæ. The material was so fragile that it crumbled under even delicate handling, but a few specimens of parts of the ant comb, with entire cells, were preserved and exhibited. Reference was made to the late Mr. Bell's opinion that these leaf-paper masses were used as a sort of "mushroom garden," a minute fungus being purposely cultivated upon them, which the ants used for food. Mr. McCook's specimens, when submitted to the microscope, did

indeed show the appearance of such growth, which, however, is only what might have been expected under such environment. The belief was expressed that the ants fed upon the juices of the leaves. But (if investigations in progress shall succeed) it was hoped that the subject of the true food of the cutting ant would be hereafter solved.

5. *Tunnelled Tracks.*—The ability of these emmet masons to excavate vast halls and subterranean avenues is remarkable. Several holes in the vicinity of Austin were visited, out of which "beds" or nests of ants had been dug, by an old man who used to follow the business of ant killing. These holes were nearly as large as the cellar for a small house. One such excavation, about three miles from Austin, was 12 feet in diameter and 15 feet deep. At the lowest point had been found the main cavity, quite as large as a flour barrel, in which were found many winged insects, males and females, and quantities of larvæ. This nest was situated 669 feet from a tree that stood in the front yard of a house which the ants had stripped. Mr. McCook took the range of the underground way traversed by the ants to reach this point, from which an accurate route was constructed and exhibited. The course varied very little from a direct line. Two branch tunnels were made to a peach orchard 120 feet distant. Reference was made to a paper by Dr. Lincecum in the Proceedings of the Academy, which gave an account of the tunnelling of a stream by these ants. There is nothing improbable in this, as the tunnel above referred to went down in places as deep as 6 feet, the average, however, being about 18 inches. At the exit hole the tunnel was 2 feet from the surface. The digging operations were described, in which the small forms alone seemed to take part. The large forms would therefore appear to assist in opening the gates, make the excursions, and do the cutting; the small forms to do the digging, or at least the carrying out of excavated earth, while the minims, or least forms, assist in opening and closing doors and keeping charge of the larvæ. The minims are quite ferocious in attack, and gallantly support the large headed soldiers.

6. *Origin of Castes by Evolution.*—This wide differentiation of form among the insects of one species and nest is one of the most serious special difficulties which the English evolution hypothesis has encountered. Dr. Darwin, with that candor which always wins him the respect and confidence of all sincere minded opponents, fully admits this, and endeavors at some length to meet it. The knot of the difficulty lies in the fact that the worker castes are sterile, and are produced from eggs laid at different periods by the female. Supposing therefore that profitable or other modifications had occurred in the workers, how, on the principle of natural selection and hereditary transmission could these operate upon such workers? All modifications of structure must be wrought and transmitted through the female alone, effecting thus

the worker-life enwrapped in the egg. But it appears quite impossible to comprehend how any structural modifications could act from the worker upon the queen in order to thus react upon a succeeding generation of workers. The illustrations which Dr. Darwin cites,<sup>1</sup> the variation of domestic cattle by interbreeding, and M. Verlot's experiments with certain double annual flowers, if admitted to throw some light upon the inquiry, yet require an efficient superintending human intelligence, which cannot be supposed to have its analogue in the perpetuation and development of ant forms, unless, indeed, we may believe that the evolution hypothesis implies and requires the interposition of a Personal Intelligence infinitely superior to that of both ant and man.

The precise sense in which the workers may be called "sterile" admits of some question. Sir John Lubbock has recently shown that parthenogenetic eggs are sometimes produced by worker-ants in artificial formicaries, from which males alone are hatched. This is according to the analogy of other Hymenopters, as for example, bees and wasps. Here, then, there may be possible escape from Dr. Darwin's difficulty more satisfactory than that which he himself suggests; for it is conceivable that an opportunity might thus be opened for the transmission of a profitable variation which might arise in a worker. Still, the difficulty appears impassable. One must suppose the growth and maturity of one such parthenogenetic male, produced from a worker with such useful modification, to have been contemporaneous with the maturity of the females of a "swarm;" this male, together with the males hatched directly from eggs laid by the queen shall have gone forth, as is the habit of ants, in the regular marriage flight, or "swarming;" and therein shall have met a virgin queen. As the modification thus supposed to be transmitted, must, on the hypothesis, be very minute, it could have been saved from obliteration, only by supposing it fortified by the recurrence of other contingencies of like character in succeeding generations. Mr. McCook therefore concluded that the development by natural selection, according to Dr. Darwin's hypothesis, of so many and widely varied forms as exist in the cutting ant, requires a series of contingencies so multiplied and remote as to forbid a reasonable hope of its probable occurrence, even with the additional favoring circumstance of occasional males parthenogenetically produced.

He added that some of the points which Dr. Darwin had raised as to the structure of the driver ant of Africa were being carefully examined by him in the case of *Atta fervens*, with the best microscopic helps at his command. Thus far, however, after a quite careful examination, nothing that can suggest the idea of an interblending of the castes by rudimentary forms had been discovered. The lowest castes of minims, in all specimens examined, with special reference to the mouth organs and eyes, showed the

<sup>1</sup> *Origin of Species*, p. 227.



same structure, in equal definiteness and perfection, as the larger castes. Allusion was also made to the ravages of these destructive insects, and some of the modes for exterminating them were explained.

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FEBRUARY 18.

The President, Dr. RUSCHENBERGER, in the chair.

Thirty persons present.

A paper entitled "On the Structure of the Chimpanzee," by H. C. Chapman, M. D., was presented for publication.

*On Bothriocephalus latus*.—Prof. LEIDY exhibited specimens of a tape worm, which had been submitted to him for determination by Dr. John T. Walker. The specimens consist of about a dozen portions of what appear to have been four or five individuals, all of them unfortunately without the head. They were discharged by a man, aged 28 years, formerly a farmer, a native of Sweden, who came to this country about three months since. At irregular intervals during the last five years the patient passed fragments, of a few inches, of the worm. According to Dr. Walker, the collective measurements of the specimens presented he had estimated to be upwards of 100 feet. In their contracted condition, as preserved in alcohol, none of the mature segments measured over 4 mm. in length by 10 mm. in breadth. These are quite characteristic of *Bothriocephalus latus*. The egg pouches of the uterus centrally situated are rendered distinct from the ripe eggs which give to them a chocolate-brown appearance. The genital apertures are in the median line, nearer the anterior border of the segments. In *Tænia*, the genital apertures are at the lateral margin of the segments.

The specimens were regarded as of special interest from the circumstance that they were the first of the *Bothriocephalus latus*, that Prof. L. had had the opportunity of seeing from a person living in our country.

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FEBRUARY 25.

The President, Dr. RUSCHENBERGER, in the chair.

Twenty-seven persons present.

*Asphaltum and Amber from Vincenttown, N. J.*—Mr. E. GOLD-SMITH remarked that he had received from Col. T. M. Bryan a specimen of asphaltum, a mass of which, weighing about a hundred pounds, had been found in the ash marl, a layer above the green sand proper, about 16 feet from the surface, in the neigh-